

## Analyzing Functional Language: EXAMPLE 2 LAUNDRY DETERGENT

The invention is a laundry detergent comprising a variant alpha-amylase enzyme. A specification excerpt follows:

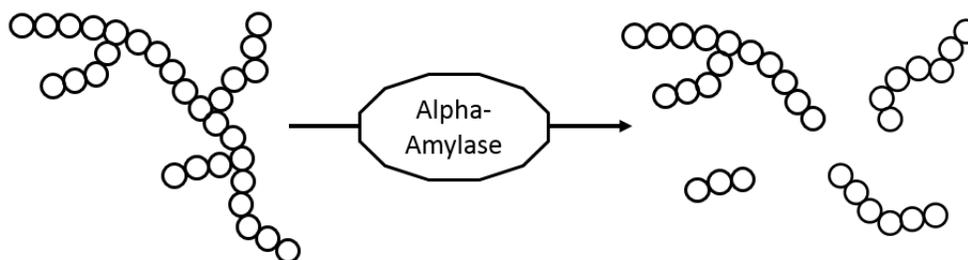


FIG. 1: Hydrolysis of starch (on left) to smaller saccharides (on right)

Alpha-amylase enzymes are specialized proteins that break down large polysaccharides such as starch into smaller saccharide units by severing the chemical bonds between adjacent sugar units. These enzymes are widely used in detergents and cleaning products to remove starch-based stains from clothing, however, these enzymes are sensitive to heat and either stop working or work at reduced efficiency when exposed to the high temperatures (*e.g.*, 80-90 °C) used in some washing machines. For example, a naturally occurring bacterial alpha-amylase known as “BSG” loses 50% of its activity at temperatures above 80 °C, and loses all of its activity at temperatures above 90 °C. The naturally occurring sequence of BSG is disclosed as SEQ ID NO: 6.

The laundry detergents of the present invention comprise a variant alpha-amylase enzyme, and one or more cleaning adjuncts such as a bleach, fragrance, or surfactant. The variant enzymes are genetically modified variants of BSG. The variants contain non-natural sequence modifications such as substitutions, deletions, or insertions, but must retain at least 90 percent sequence identity to BSG (SEQ ID NO: 6) in order to retain their alpha-amylase activity. Most of the variant enzymes have the same sensitivity to heat as BSG, *i.e.*, they lose 50% of their enzymatic activity at temperatures above 80 °C, and lose all of their activity at temperatures above 90 °C.

In a preferred embodiment, the laundry detergent composition has increased thermostability at high temperatures relative to BSG. In the context of the present invention, “high temperature” means temperatures from 80-100 °C, preferably about 90 °C, and “increased thermostability” means that more enzymatic activity is retained relative to BSG for at least 30 minutes. Thus, when exposed to a temperature of 90 °C, a preferred laundry detergent composition having “increased thermostability” will retain some measurable enzymatic activity for at least 30 minutes, whereas a laundry detergent composition comprising BSG will not retain any enzymatic activity. It is known in the art that increased thermostability of an enzyme-based detergent composition can be achieved by multiple approaches including sequence modifications of the enzyme, covalent attachment of a stabilizer molecule to the enzyme, adjusting the pH of the laundry detergent composition, or addition of a stabilizer molecule to the laundry detergent composition, and that each approach produces a different result. In a preferred embodiment, the means for providing increased thermostability to the laundry detergent composition is a sequence modification of the enzyme such as a substitution at one or more positions corresponding to positions 50, 61 and 105 of SEQ ID NO: 6.

The following set of hypothetical claims shows variations on the use of functional language.

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### What is claimed is:

1. A laundry detergent composition comprising:

- a) a cleaning adjunct selected from the group consisting of a bleach, a fragrance, and a surfactant; and
- b) a variant alpha-amylase enzyme having an amino acid sequence that has at least 90% identity to SEQ ID NO: 6,

wherein the laundry detergent composition has increased thermostability at high temperatures relative to BSG.

2. A laundry detergent composition comprising:

- a) a cleaning adjunct selected from the group consisting of a bleach, a fragrance, and a surfactant; and
- b) a variant alpha-amylase enzyme having
  - (i) an amino acid sequence that has at least 90% identity to SEQ ID NO: 6, and
  - (ii) one or more substitution modifications at positions corresponding to positions 50, 61 and 105 of SEQ ID NO: 6,

wherein the laundry detergent composition has increased thermostability at high temperatures relative to BSG.

3. A laundry detergent composition for increased thermostability during high-temperature washes comprising:

- a) a cleaning adjunct selected from the group consisting of a bleach, a fragrance, and a surfactant; and
- b) a variant alpha-amylase enzyme having
  - (i) an amino acid sequence that has at least 90% identity to SEQ ID NO: 6, and
  - (ii) one or more substitution modifications at positions corresponding to positions 50, 61 and 105 of SEQ ID NO: 6.

4. A laundry detergent composition comprising:

- a) a cleaning adjunct selected from the group consisting of a bleach, a fragrance, and a surfactant; and
- b) a variant alpha-amylase enzyme having
  - (i) an amino acid sequence that has at least 90% identity to SEQ ID NO: 6, and
  - (ii) one or more sequence modifications that cause the variant alpha-amylase enzyme to have increased thermostability relative to BSG.

5. A laundry detergent composition comprising:

- a) a cleaning adjunct selected from the group consisting of a bleach, a fragrance, and a surfactant; and
- b) a variant alpha-amylase enzyme having an amino acid sequence that has at least 90% identity to SEQ ID NO: 6, with
- c) means for causing the variant alpha-amylase enzyme to have increased thermostability relative to BSG.